

**MICRO-SURFACING MSP-97-03L**

1.0 Description. This specification covers materials and construction requirements for producing and placing a mixture of cationic latex modified asphalt emulsions, mineral aggregates, portland cement, water, and a set retarder in locations shown on the plans. Typical locations are roadway surfaces, bridge decks, or shoulders. In some cases, more than one lift may be required to obtain any specified thickness.

1.1 Note - There are three different pay items possible. Any or all three applications might be used. Type A is typically used for light (<3500 ADT) traffic application and no rutting. Type B is typically used for minor (<1/2" or <13mm) rutting and for heavier traffic applications. Type B is applied in 2 lifts, the first of which is intended to level or fill low areas, followed by the final lift to complete the quantity specified. Type R is used for filling deeper ruts or otherwise raising grade (e.g., dropped shoulders) to a level elevation in a single lift and typically then followed by A or B as needed for the traffic level.

1.2 Unless otherwise allowed, the mixture shall set to allow rolling traffic on a 1/2 inch (13 mm) thick surface within one hour after placement at 75 F (25 C) and 50 percent humidity.

2.0 Materials.

2.1 Emulsion. The emulsion shall be a latex modified asphalt emulsion and shall be a grade CSS-1h. It shall show no separation after mixing. A minimum of 2.5 percent latex content, by mass, of an approved latex shall be milled into the asphalt emulsion at the time of manufacture of the emulsion. The emulsion shall be sampled in accordance with AASHTO T 40 and shall comply with the following requirements:

	Min	Max	Test Method
Test on Emulsion			
Viscosity, Saybolt Furol at 25 C,s	20.00	100.00	AASHTO T 59
Storage stability test, 24 hr, percent	- -	1 (a)	AASHTO T 59
Particle charge test	positive (b)		AASHTO T 59
Sieve test, percent	- -	0.50	AASHTO T 59
Distillation:			
Residue, percent	57.00	- -	AASHTO T 59
Tests on Residue from Distillation Test			
Penetration, 25 C, 100 g, 5s,	40.00	90.00	AASHTO T49
Ductility, 25 C, 5cm/min, cm,	40.00	- -	AASHTO T 51
Solubility in Trichloroethylene, percent	97.50	- -	AASHTO T 44

Note: (a) The storage stability test may be waived provided the asphalt emulsion storage tank at the project site has adequate provisions for circulating the entire contents of the tank, and provided satisfactory field results are obtained.

(b) If the particle charge test is inconclusive, material having a maximum pH value of 6.7 will be acceptable.

2.2 Mineral Aggregate. The mineral aggregate shall meet Sec 1002.1 and be flint chat from the Joplin area, an approved crushed porphyry or an approved crushed steel slag. Blast furnace slag may be used from sources with a documented history of satisfactory use, that have been previously approved by MoDOT for use in micro surfacing. For nontraffic areas such as

shoulders, the mineral aggregate may also be crushed limestone or crushed gravel meeting the requirements of 1002.1. The aggregate shall be free of cemented or conglomerated lumps and shall not have any coating or injurious material.

2.2.1 Blends of approved aggregates may be supplied provided: a) the individual aggregates are reasonably uniform in gradation and other qualities, b) they are uniformly blended with designated proportions using calibratable cold feeds with controlled feeders into a separate stockpile prior to use, and c) the proportion is not changed from that used for themix design during the course of placement. However, aggregate may also be blended directly into the nurse truck provided the blending device has been calibrated, gate settings are unchanged, and belt samples indicate material gradation compliance.

2.2.2 The final aggregate, or blend of aggregates, shall comply with one of the following gradations. The aggregate shall be within the specified gradation, and in addition, shall be ± 5 percent of the designated job mix gradation for all + No. 200 (75 μ m) material and within ± 2 percent for the minus No. 200 (75 μ m) material.

Gradation 1		Gradation 2	
Sieve	Percent Passing	Sieve	Percent Passing
½ inch (12.5 mm)	100.00	3/8 inch (9.5 mm)	100.00
3/8 inch (9.5 mm)	95 – 100	No. 4 (4.75 mm)	90 – 100
No. 4 (4.75 mm)	85 – 95	No. 8 (2.36 mm)	65 – 90
No. 10 (2.0 mm)	40 – 60	No. 16 (1.18 mm)	45 – 70
No. 40 (425 μ m)	12 – 30	No. 30 (600 μ m)	30 – 50
No. 80 (180 μ m)	8 – 22	No. 50 (300 μ m)	18 – 30
No. 200 (75 μ m)	5 – 15	No. 100 (150 μ m)	10 – 21
		No. 200 (75 μ m)	5 - 15

2.2.3 The final aggregate mixture shall meet the required gradation with no oversize material when deposited at the stockpile site. If the stockpile area contains any oversize at all, i.e., any particles exceeding the specified maximum sieve, all aggregate shall be screened again as it is loaded into the final placement machine.

2.3 Portland Cement. Portland cement shall be Type 1 and shall be free of lumps or any other deleterious material.

2.4 Water. Water shall be potable and free of harmful soluble salts.

2.5 Special Additives. These additives are any other materials that are added to the mixture or to any of the component materials, to provide the required properties. All additives shall be supplied by the emulsion manufacturer.

2.6 Material Acceptance. The micro-surfacing system, including materials and procedures, shall be prequalified prior to being offered for use. To become prequalified the micro-surfacing manufacturer shall contact the State Materials Engineer. Prequalification requirements may include but are not restricted to laboratory samples, company test results, use history, and field demonstrations. The engineer will notify the manufacturer when prequalification has been completed. After a material has been prequalified, subsequent prequalifications will not be required so long as the material is not changed and so long as satisfactory results are obtained in the field. Materials evaluated prior to this specification have been added to the list of prequalified materials.

2.6.1 The applicable requirements of Sec 1015, unless modified herein, shall apply when offering emulsion for use.

2.6.2 The asphalt emulsion manufacturer shall certify that the latex and any special additives are the same as those which were prequalified. At the beginning of the project, three copies of the certification shall be furnished to the engineer.

2.6.3 All aggregates will be sampled, tested, and approved by the engineer, prior to use.

2.6.4 Portland cement may be accepted for use based on visual examination.

2.6.5 Water shall be approved by the Missouri Department of Natural Resources for drinking purposes.

3.0 Mix Design. The manufacturer of emulsion shall develop the job mix formula and present certified test results for the engineer's approval. The mixture shall be designed according to procedures in Appendix A and shall have a minimum Marshall stability of 8000 pounds (35586 Newtons). In lieu of that procedure, mixes designed in accordance with International Slurry Surfacing Association (ISSA) recommended standards by an ISSA recognized laboratory and meeting those requirements will be accepted, subject to satisfactory field performance.

3.1 Proportioning and Quantity Requirements. The engineer will approve the design mix and all materials and methods prior to use and shall designate the proportions to be used within the following limits. If more than one aggregate is used, they shall be blended in designated proportions as indicated in the mix design, and those proportions maintained throughout the placement process. If aggregate proportions are changed, a new mix design shall be obtained.

Material	Requirement
Type A Mineral aggregate, lb/sy (kg/m ²) dry mass, min.	20 (10.8)
Type B Mineral aggregate, lb/sy (kg/m ²) dry mass, min.	36 (19.5)
Type R Mineral Aggregate to fill to top of grade	As necessary
Latex Modified Emulsion (Residual), percent	6.5 min.
Portland Cement, percent by mass of dry aggregate	0.5 to 2.5
Additive	As required

3.1.1 All Types. The minimum dry mass per unit area is based on a bulk specific gravity (BSG) of 2.65. In the event that crushed steel slag aggregate is used as a part of the blended aggregate, or as the entire aggregate, the BSG of the final aggregate blend shall be determined and shown as part of the mix design criteria. If the BSG is different from 2.65 by more than 0.05, the above minimum masses shall be adjusted by dividing the specified unit mass by 2.65 and multiplying by the new BSG. e.g., for a new BSG = 3.15, the new minimum would be $3.15(10.8/2.65) = 23.8$ lb./sy (12.8 kg/m²). These adjusted values shall be designated on the mix design and shall apply in the field.

3.1.2 Type A. For Type A, if a specified thickness is required, the amount of mineral aggregate per square yard (meter) shall be increased as necessary to obtain the thickness.

3.1.3 Type B. When Type B is specified, it shall be applied in two passes of approximately equal quantities, the first of which is a level course to fill depressions and level the surface for the final pass.

3.1.4 Type R. There are no minimum or maximum unit quantities for Type R. The contractor

shall make the determination as to the amount necessary, however all depressed areas re to be filled level as specified. Type R may be applied in more than one pass at no additional pay. Type R shall not be added to Type A or B applications in the field, but shall remain a separate application.

4.0 Equipment.

4.1 Mixing Equipment. The micro-surfacing mixture shall be mixed and laid by a self propelled mixing machine which shall be able to accurately deliver and proportion the aggregate, portland cement, water, additive and emulsion to a revolving multi-blade dual mixer and discharge the thoroughly mixed product. The machine shall have sufficient storage capacity for aggregate, emulsified asphalt, portland cement, water and additive to maintain an adequate supply to the proportioning controls. The machine shall be continuous loading and be operated in that manner.

4.1.1 Individual volume or weight controls for proportioning each item to be added to the mix shall be provided. Each material control device shall be calibrated and properly marked. They shall be accessible for ready calibration and so placed that the engineer may determine the amount of each material used at the time.

4.1.2 The mixing machine shall be equipped with a water pressure system and nozzle type spray bar to provide a water spray to dampen the surface when required immediately ahead of and outside the spreader box as required. No free flowing water shall be present.

4.2 Spreading Equipment. The micro-surfacing mixture shall be spread uniformly by means of a mechanical type spreader box attached to the mixer. The spreader box shall be equipped with paddles or augers to agitate and spread the materials uniformly throughout the box. The paddles or augers shall be designed and operated so all the fresh mix will be agitated and to create a turbulence or laminar flow to prevent the mixture from setting up in the box, causing side buildup and lumps.

4.2.1 The spreader box used for surface course construction shall be equipped with flexible seals in contact with the road to prevent loss of mixture from the box. The box shall be equipped with devices to adjust thickness or grade of the surface and shall have a squeegee strike-off rear plate.

4.2.2 The spreader box used for rut filling shall have two metal strikeoffs, angled from each side toward the center at approximately 45 degrees. Interrupted flight augers are required ahead of the first strike-off plate to spread the mix and maintain laminar flow. The second strike-off plate is adjusted to produce the desired grade and depth. The first strike-off and augers shall be adjustable up and down in order to maintain a fairly uniform flow or roll of material in front of the second strike-off. A rubber squeegee shall be attached to the adjustable metal plate at the rear of the spreader box, behind the second strike-off, to texture the surface. The adjustable metal plate shall have sufficient clearance not to affect the grade established by the second strike-off.

5.0 Construction Requirements.

5.1 Test Strip. A test strip 500 feet (150 meters) in length and the width of one lane shall be provided prior to any production. The test strip shall be evaluated for 24 hours and shall be approved by the engineer before any further production. If unsatisfactory, it shall be removed and another strip placed for evaluation. No additional payment will be made for test strip placement.

5.2 Surface Preparation. Immediately prior to applying the micro surfacing, the surface shall be thoroughly cleaned of all vegetation, loose materials, dirt, mud, and other objectionable materials and pre-wetted as required.

5.3 Application. The micro-surfacing mixture shall be spread to fill cracks and minor surface irregularities and leave a uniform surface. Approved tools shall be used to spread the mixture in areas inaccessible to the spreader box and other areas where hand spreading may be required. A sufficient amount of material shall be carried in all parts of the laydown box at all times so that complete coverage is obtained. No unmixed aggregate, lumps or balls shall be permitted in the finished surface. The seam where two passes join shall be neat in appearance. All excess material shall be removed from ends of each run immediately. Any successive passes shall be separated such that the each layer placed undergoes at least 1 full period of overnight traffic for compaction and curing prior to being overlaid.

5.3.1 Type R applications to raise shoulders or fill ruts shall be applied with the rut spreader box and shall place a strip as designated on the plans or in the contract to raise an area to match the surroundings. Rutting or traffic bearing (but not shoulders) applications shall be crowned 1/8-1/4" per inch of depth (3-7 mm per 25 mm of depth), to allow for compaction. Shoulder applications shall drain and shall slope uniformly downward to the shoulder point. If specified in the contract or plans, a Type A or B application may follow as a surface course.

5.3.2 Micro-surfacing shall not be placed over steel expansion plates.

5.3.3 When micro-surfacing is placed on concrete, a tack coat shall be applied first in accordance with Sec. 407 and given adequate time to break.

5.4 Weather Limitations. The modified paving system shall not be placed (1) when either the air temperature or the temperature of the surface on which the mixture is to be placed is below 50 F (10 C), (2) when it is raining, or (3) when there is a chance of temperatures below 32 F (0 C) within 24 hours.

5.5 Any traffic damaged or marred areas shall be repaired by the contractor at no additional charge.

5.6 Areas that cannot be reached with the mixing machine shall be surfaced using hand squeegees to provide complete and uniform coverage. Utilities shall be protected from coverage by a suitable method. Work at intersections shall be done in stages, or blotter materials shall be used, to allow crossing or turning movements. Regardless of the method, no marred sections will be allowed.

6.0 Method of Measurement. Measurement of Type A, B and R micro-surfacing complete in place will be made to the nearest square yard (meter). Final measurement of completed Type A and B surface will not be made except for authorized changes during construction, or where appreciable errors are found in the contract quantity. Final measurement of Type R surface may be made as necessary to determine the actual areas placed. Field measurement will be based on the estimated width and length dimensions necessary to bring a designated area to a level plane, and not necessarily for the full wetted area. The revision or correction will be computed and added to or deducted from the contract quantity.

7.0 Basis of Payment. The accepted quantity of micro-surfacing will be paid for at the contract unit price for Micro-surfacing, Type A, B or R per square yard (meter).

APPENDIX A: MIX DESIGN PROCEDURES

1. Compatibility.

- (a) Small amounts of aggregate are hand mixed with 2 percent portland cement.
- (b) Water and additive are added and mixed in quickly.
- (c) 10 to 11 percent emulsion is added and mixed for 20 to 40 seconds then poured out to make a patty.
- (d) The total time from mixing to breaking is recorded and cohesion tested by lifting the patty's edge.

2. Stability.

- (a) Marshall specimens are developed in the normal fashion using AASHTO T 245 for Bituminous Hot Mix concrete.
- (b) PG 58-22 asphalt binder (normal emulsion base stock) should be used and mixed with the selected aggregate.
- (c) The recommended percent residual is 6.5 percent minimum.
- (d) Marshall specimens are made and tested in accordance with AASHTO T 245 procedures for the asphaltic concrete mixtures.

After the asphalt content, stability, flow and voids content have been established using PG binder, the asphalt content is converted to make mixes using latex modified emulsion mix.

3. Mixing and testing procedures.

- (a) Enough aggregate is used to prepare three specimens at each asphalt content percent. The moisture content must be calculated and ambient temperatures observed throughout.
- (b) Adequate amounts of aggregate and portland cement are mixed with the proper percentages of water and additive in a power mixer.
- (c) The earlier obtained asphalt content is converted to percent of latex modified emulsion by dividing by $64 \pm 1/2$ percent residual in the latex emulsion. This mass of emulsion, calculated as a percentage of the dry mass of aggregate and portland cement combined is added and mixed (e.g., 6.4 percent residual requires 10 percent emulsion). The proper mass of emulsion must be preweighed and added to the mixer bowl quickly. While blending, or shortly thereafter, the emulsion will begin to plate on the stone very rapidly.
- (d) Mixing is continued until a crumbly, well-coated material is obtained. This material is then open-air dried for 2 to 3 days.
- (e) After air-drying, the material is oven heated to an asphalt temperature used in the hot mix control test phase (usually about 140 C). The material is then compacted in preheated molds as described in AASHTO T 245. Hot spots should be avoided when heating this mixture.
- (f) The Marshall specimens are placed in a 60 C water bath and tested as per AASHTO T 245.